FACTSHEET

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Ontario Ministry of Agriculture, Food and Rural Affairs

NUTRIENT MANAGEMENT ACT
LIQUID MANURE REMOVAL FROM STORAGE

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(Replaces OMAFRA Factsheet *Liquid Manure Removal from Storage,* Order No. 85-010, Printed February 2006)

The Nutrient Management Act (NMA), 2002, which took effect September 30, 2003, outlines important aspects related to the handling and storage of manure and other nutrients on farms. Under the NMA regulation, farms are phased in according to the nutrient units they generate or based on the application for a building permit to house farm animals or to store manure.

INTRODUCTION

The handling of liquid manure in a livestock operation is made up of several individual operations. The removal of manure from long-term storage is the operation that usually presents the most problems. The information presented here deals with the removal of the liquid manure from storage.

Solid manure is defined in the NMA 2002, O. Reg. 267/03, as amended, as either:

- having a dry matter content of 18% or more, or
- having a slump of 150 mm (6 in.) or less using the Test Method for the Determination of Liquid Waste (slump test) set out in Reg. 347, Sch. 5 of the Environmental Protection Act.

Liquid manure therefore has a dry matter content of less than 18% or a slump of 150 m, (6 in.) or more and cannot be handled with a manure fork.

TYPES OF MANURE STORAGES

Liquid manure is stored in many different types of storages. They may be open-topped or covered with a roof or under a building with slats or a solid floor. Most storages under the barn are rectangular, constructed of concrete and usually have compartments. The storage may be wider than the barn or of the same dimensions.

Storages outside the barn may be rectangular, square or round and have straight or sloped walls. Construction materials may be earth, concrete, steel or a combination of these materials. They can be constructed above ground, below ground or partly below ground and the depth of storage can vary.

All manure storages are to be constructed according to the Ontario Building Code (with the exception of earthen storages) and O. Reg. 267/03, as amended. Since the Ontario Building Code does not cover earthen storages, the municipal building official does not inspect them.

The requirements for transferring liquid manure to the storages are outlined in O. Reg. 267/03 and other information sheets prepared by this ministry. Other requirements related to the construction and operation of liquid manure storages are contained in the regulation O. Reg. 267/03.

MANURE REMOVAL EQUIPMENT

The many different types of storages means a large array of equipment is necessary to match the style of storage.

Vertical Pumps

These pumps are designed to operate in the vertical position and are used to remove manure from storages under barns and from small temporary storages (*Figure 1*). Usually these pumps are driven with an electric motor and thus are limited in capacity. They are also used in outside storages where the storage is below the level of the tractor that is used to power the pump (*Figure 2*). See Canada Plan Service Plan No. 10706, *Clay-Lined Manure Storage Pond With Pumping Dock* and 10730, *Below Ground Open Circular Manure Storage Tank and other storages*. These pumps are mounted on a

set of wheels for ease of transportation to different storages. Hydraulic cylinders tip the pump into the horizontal position for transport and raise and lower the pump into the storage.

The tractor powered pumps range in capacity from 14,000–23,000 L/min. (3,600–6,000 U.S. gal/min.). Power requirements range from 49–135 kW (65– 180 hp).

FIGURE 1. Electric driven chopper/agitator pump for use in temporary storages.

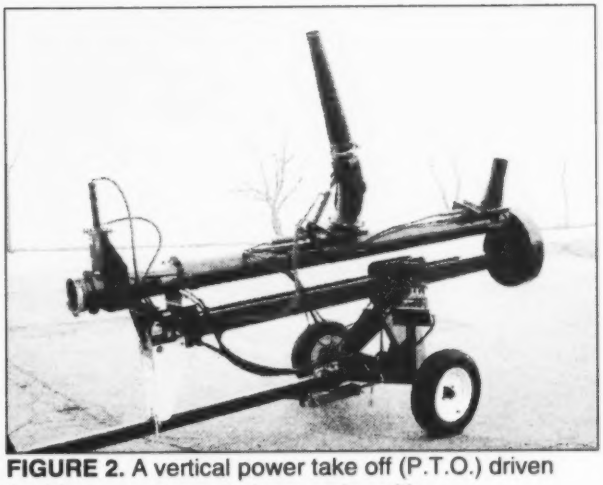

FIGURE 2. A vertical power take off (P.T.O.) driven liquid manure pump in transport position.

Side Mounted Pumps

Side mounted pumps are used with storages that have vertical walls and are either above or partly above ground. They are mounted permanently on the outside of the storage and are P.T.O. driven. Manure flows out the bottom of the storage through a large diameter pipe and into the pump. From there the manure is recycled back into the storage for agitation or out into the tankers for spreading.

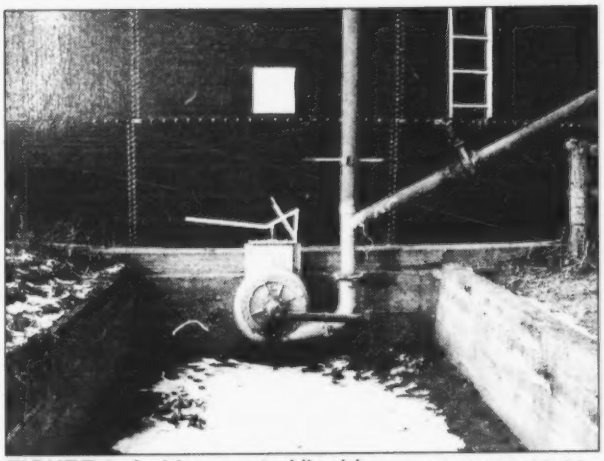

FIGURE 3. A side mounted liquid manure pump on an above ground, steel, manure storage.

Earthen Manure Storage Pumps

Liquid manure storage pumps are available for storages with earth walls and/or sloped concrete ramps. They are also used in large below ground storages where the pump can be inserted into the storage on an angle. These pumps are mounted on wheels for transporting. They have long power shafts that allow the impeller section of the pump to be backed down the side of the storage and into the manure. The pumps have various lengths of power shafts for storages of different sizes. Most pumps are manufactured with reaches varying from 6–12 m (20–40 ft.).

Since earthen storages and some concrete storages can be quite large, special propeller type agitators are available (*Figure 4*). These agitators are strictly for blending the manure before removing from storage. They consist of a 3-point hitch frame, a long power shaft and a propeller. They can be lifted or lowered to enable the operator to break up heavy surface crusts or lift settled solids off the bottom of the storage. Pumps with hydraulically controlled nozzles can also be used for this purpose, when the level of the liquid in the storage is lowered.

Some pumps have an auxiliary propeller mounted on them. This allows the one unit to agitate, pump, or agitate and pump at the same time.

All pumps can, through valving, recycle the output of the pump back into the storage for agitation. They can also direct the output through 102–152 mm (4–6 in.) pipes to a manure tanker. The output of the pump, when recycled back into the storage, can be directed so as to achieve thorough mixing in the storage.

FIGURE 4. For large storages or adverse conditions, a propeller agitator is used to break up the manure before removal.

EMPTYING PROCEDURE

The ability to agitate and pump liquid manure depends greatly on the moisture content of the manure. Pumping and agitation becomes more difficult as moisture content of manure is reduced. For this reason thoroughly mix the manure before removing most of the liquid. This is especially true where the storage is particularly large and/or the tractor agitating is slightly under-sized. Agitation time varies from 2–8 hours or longer, depending on conditions.

Large storages may require more than one pumpout location. Be sure and check with equipment dealers to determine the number of locations required.

CAUTION

Agitation of liquid manure storages results in the release of deadly manure gases. Extreme caution must be exercised where gases can accumulate in an enclosed space such as removal of manure from a slatted floor barn. See OMAFRA Factsheet *Hazardous Gases*, Order No. 99-001.

FIGURE 5. Agitating manure in a 39 m (128 ft.) diameter by 5 m (16 ft.) deep concrete storage.

Take manure samples for nutrient and dry matter analysis to be used in the Nutrient Management Plan after the manure is thoroughly agitated. Empty the storage when sampling is complete. Many operators remove the high-powered tractor from the agitator and use it to haul a liquid tanker. A smaller tractor can then be used to pump manure into the tankers and to keep the previously agitated manure in suspension.

FIGURE 6. Loading 11,400 L (3,000 gal.) tankers after agitating manure.

The pumps available have a high capacity in relation to the size of the tanker. This means that in average conditions a large tanker can be filled in minutes. Therefore it is important the proper conditions exist so the tanker can be moved quickly into and out of position for loading (*Figure 6*).

Similar to solid systems, as large a tanker as practical reduces the number of trips to the field. This means more efficient use of equipment and labour. In some instances the manure is hauled to remote fields with semi-trailers that are parked in the field. The tankers are then filled from the semi-trailer and used only for manure application. This option is becoming more popular as tankers are fitted with extra equipment to inject or bury the liquid manure. Spreaders can be filled at the storage using lagoon pumps, sucking the material from the storage or sucking the material from a large semi-trailer parked in the field. The equipment is designed to limit the exposure of manure to the atmosphere, thereby minimizing odours.

Spreading equipment is available where the application rate is controlled by Geodetic Information Systems (GIS). This equipment matches the application rate to the previously determined soil test requirements, based on the nutrient content of the manure.

CAUTION WITH RACEWAY SYSTEMS

Circulatory or raceway systems are commonly used in slatted floor barns and consist of a series of interconnected narrow channels. A propeller type agitator

is inserted into the storage in one location and agitates the manure by circulating it around the channels (*Figure 7*).

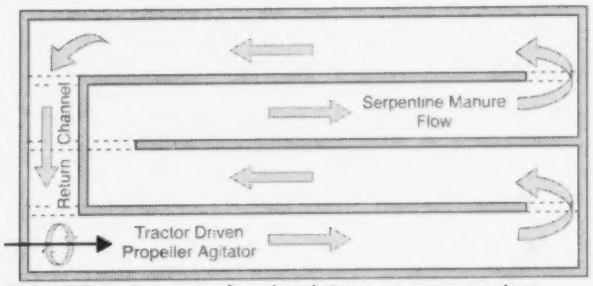

FIGURE 7. Layout of a circulatory manure system.

Problems arise if the manure does not start to circulate right away when the propeller agitator is started (*Figure 8*). The manure level can rise sufficiently behind a plug of solid manure that slates are lifted off the channel walls. In some instances, when the weight of the slats is removed from the top of the wall, the walls may move from lack of lateral support. The slats and animals then fall into the manure storage, resulting in the death of animals and structural failure.

To avoid problems, agitate the manure when the tank is half full to breakup the surface crust and agitate again before emptying. If unable to stir the manure twice, run the agitator slowly until the manure starts to circulate completely.

Take care to keep manure turbulence to a minimum to avoid excessive release of deadly gases. Make sure that all people and livestock are as far away from the area being agitated as possible and open the barn to provide extra ventilation.

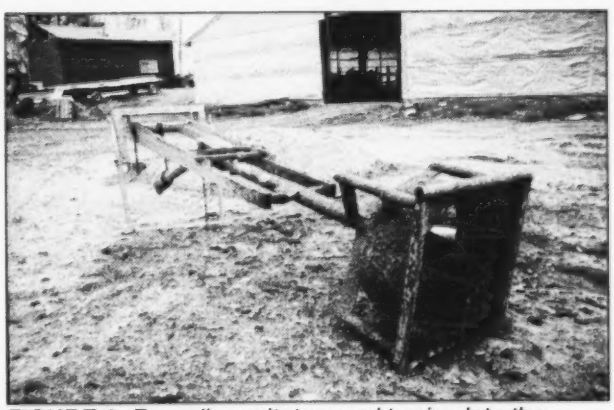

FIGURE 8. Propeller agitator used to circulate the manure in a raceway manure storage system.

SAND BEDDED SYSTEMS

A majority of liquid manure systems use organic material such as straw, shavings or sawdust for bedding. However in the dairy industry sand is regularly used to enhance udder health and for various other reasons. The properties of sand require a different management style for removing from storage and it is particularly abrasive on manure-handling equipment.

It is difficult to keep sand in suspension by agitation in order to remove it with the liquid portion of the manure. Since sand settles to the bottom of the storage, agitation must take place at the storage bottom to force the sand into suspension. It is more difficult to achieve this with coarse sand than with finer material. Due to these difficulties, the liquid portion is generally removed first and then the sand and remaining manure is removed as a solid. Nutrient sampling should be completed for liquid and solid portions.

Hydraulic excavators are used to reach into the smaller storages while larger storages have entrance ramps where the equipment can enter the storage and load the solids. Both types of material removal require a concrete base for satisfactory long-term operation.

DIRECT FLOW APPLICATION SYSTEMS

Direct flow systems include solid set irrigation guns, travelling gun systems (hard or soft hose types), tractor pulled injection and broadcast systems, and reel systems. Ensure safety devices exist that enable the flow of material to be stopped within one minute in the event of a leak in the piping system. These safety devices must be in place for farms phased in under the NMA Regulation.

O. Reg. 267/03, s. 50 sets out the safety requirements for applying liquids by a direct flow application system. One or two operators are required based on the ability of the operators to shut down the equipment within one minute should a malfunction occur.

IRRIGATION OF MANURE

O. Reg. 267/03, s. 49 and 50 apply conditions to the irrigation of nutrients. The Regulation prohibits using high trajectory irrigation guns capable of spraying liquid more than 10 m (30 ft.) when applying manure or non-agricultural source materials unless the material being applied is greater than 99% water by weight. This restriction applies to the spreading of manure when the operation is required to have a Nutrient Management Plan.

Irrigation of non-agricultural source materials less than 99% water was banned September 30, 2003.

For more information, see OMAFRA Factsheet *Land Application of Liquid Manure in an Environmentally Responsible Manner,* Order No. 01-053.

GRAVITY LOAD-OUT FROM STORAGE

In the proper location gravity can load manure into tankers. There must be sufficient difference in elevation between the bottom of the storage and where the tanker sits while being loaded. The requirement is at least 3.6 m (12 ft.) (*Figure 9*).

The gravity system is very simple and maintenance free. It consists of a transfer pipe with 2 valves. The valve buried below ground level is for safety and should be kept closed at all times, except when unloading the storage. It must be:

- protected from frost
- able to close quickly and
- have a lock to secure the closed position.

At the outlet end of the pipe a second valve is located. This valve controls the flow when filling the spreaders. If this valve should malfunction, the safety valve can be closed.

The opening at the end of the pipe should be in the vertical position. This helps direct the manure down into the spreader. This is particularly necessary when the storage is full and the manure has a high moisture content.

Thorough agitation of the manure before emptying will break up lumps of manure, clumps of weeds and loosen settled solids. If the manure is not agitated before emptying you can expect problems with the transfer pipe plugging and a loss of storage capacity due to a solids buildup.

In most cases a 610 mm (24 in.) pipe is large enough to function without problems. Smaller diameter pipes can be used if good agitation is achieved. Often the size of pipe used is determined by what is readily available in the area. Some farmers close to a concrete plant have obtained culvert "seconds". These tiles are usually chipped at the ends but perform satisfactorily when carefully laid and the joints repaired with a suitable concrete mix.

CONCLUSION

The removal of liquid manure from storage can be done quickly and with little difficulty. It is imperative however, to have a proper moisture content and the correct equipment to achieve complete agitation with the possible exception of sand bedded systems.

Too low a moisture content, too much foreign material, improper equipment, sand bedding and not enough horsepower cause problems with agitation. Generally sand bedding is more efficiently removed as a solid. An improperly sized or shaped storage may mean that manure must be agitated that is at a distance greater than 13 m (40 ft.) from the pump. This causes difficulties. Once the manure is properly agitated it can be removed from the storage without problems.

This Factsheet was written by **Harold Cuthbertson**, Engineering and Technology Unit, OMAFRA and reviewed **Steve Clarke**, Engineering and Technology Unit, OMAFRA.

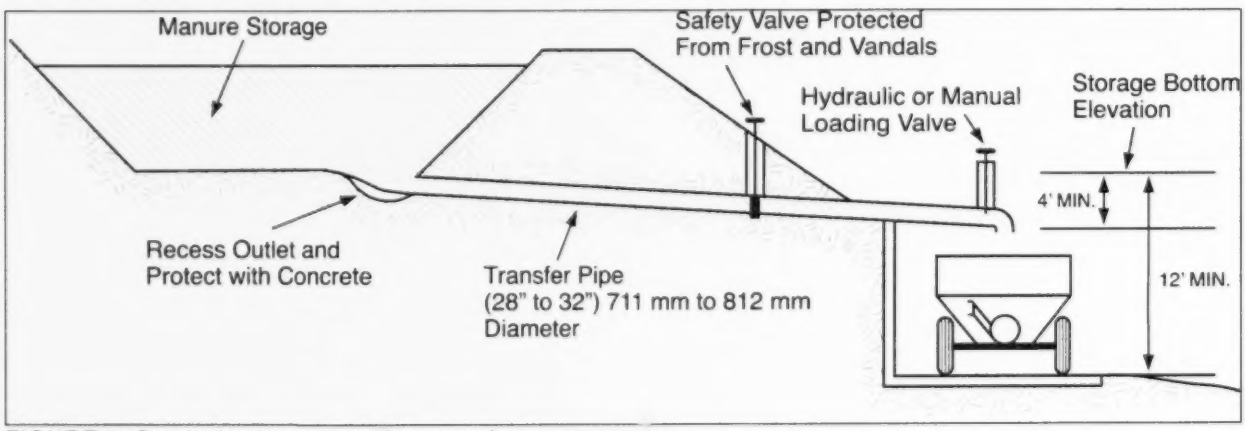
Manure Storage
Safety Valve Protected From Frost and Vandals
Hydraulic or Manual Loading Valve
Storage Bottom Elevation
4' MIN.
12' MIN.
Recess Outlet and Protect with Concrete
Transfer Pipe (28" to 32") 711 mm to 812 mm Diameter

FIGURE 9. Gravity load-out of liquid manure from storage.

FOR YOUR NOTES

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Do you know about Ontario's new *Nutrient Management Act*?

The provincial *Nutrient Management Act* (*NMA*) and the Regulation 267/03, as amended, regulates the storage, handling and application of nutrients that could be applied to agricultural crop land. The objective is to protect Ontario's surface and groundwater resources.

Please consult the regulation and protocols for the specific legal details. This Factsheet is not meant to provide legal advice. Consult your lawyer if you have questions about your legal obligations.

For more information on the *NMA* call the Nutrient Management Information Line at 1-866-242-4460, e-mail *nman@omafra.gov.on.ca* or visit *www.omafra.gov.on.ca*. Factsheets are continually being updated so please ensure that you have the most recent version.

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